Claims

1. A light emitting apparatus comprising a light emitting element, and a phosphor which absorbs a part of light emitted from said light emitting element and converts it into light with different wavelength, wherein

the surface of said phosphor is coated with a coating member which is made of a material different from the phosphor, wherein

said coating member is made of any of metal oxide, metal nitride and metal oxynitride.

2. The light emitting apparatus according to claim 1, wherein said coating member coats the surface of said phosphor whereby having a substantially smooth film.

3. The light emitting apparatus according to claim 1, wherein said coating member is formed such that a large number of fine particles relatively smaller than said phosphor aggregate to coat the whole surface of said phosphor.

4. The light emitting apparatus according to any of claims 1 to 3, wherein said coating member contains at least one metallic element selected from the group consisting of Al, Si, and In, Ga and the other rare earth elements.

5. The light emitting apparatus according to claim 1 to 4, wherein the phosphor before coating has hydration characteristics.

6. The light emitting apparatus according to claim 1 to 5, wherein said phosphor is an alkaline-earth silicon nitride phosphor.

7. The light emitting apparatus according to claim 1 to 5, wherein said phosphor is an alkaline-earth silicon oxynitride phosphor.

8. The light emitting apparatus according to claim 1 to 7, wherein the BET value of said coated phosphor is 1.0 to 10 times the BET value before coating.

9. The light emitting apparatus according to any of claims 1 to 8, wherein the

average thickness of said coating is 10 nm to 500 nm.

10. The light emitting apparatus according to any of claims 1 to 13, wherein said coating is formed in chemical vapor deposition.

11. A phosphor for a light emitting element which absorbs a part of light emitted from the light emitting element and converts it into light with different wavelength, wherein

the surface of said phosphor is coated with a coating member which is made of a material different from the phosphor, wherein

said coating member is made of any of metal oxide, metal nitride and metal oxynitride.

12. The phosphor for a light emitting element according to claim 11, wherein said coating member coats the surface of said phosphor whereby having a substantially smooth film.

13. The phosphor for a light emitting element according to claim 11, wherein said coating member is formed such that a large number of fine particles relatively smaller than the phosphor aggregate to coat the whole surface of said phosphor.

14. The phosphor for a light emitting element according to any of claims 11 to 13, wherein said coating member contains at least one metallic element selected from the group consisting of Al, Si, and In, Ga and the other rare earth elements.

15. The phosphor for a light emitting element according to claim 11 to 14, wherein the phosphor before coating has hydration characteristics.

16. The phosphor for a light emitting element according to claim 11 to 15, wherein said phosphor is an alkaline-earth silicon nitride phosphor.

17. The phosphor for a light emitting element according to claim 11 to 16, wherein said phosphor is an alkaline-earth silicon oxynitride phosphor.

18. The phosphor for a light emitting element according to claim 11 to 17, wherein the BET value of said coated phosphor is 1.0 to 10 times the BET value before coating.

19. The phosphor for a light emitting element according to claim 11 to 18, wherein the average thickness of said coating is 10 nm to 500 nm.

20. The phosphor for a light emitting element according to claim 11 to 19, wherein said phosphor is charged to a negative surface potential before coating.

21. The phosphor for a light emitting element according to claim 11 to 20, wherein said coating is formed in chemical vapor deposition.

22. A method for producing a phosphor for a light emitting element which absorbs a part of light emitted from the light emitting element and converts it into light with different wavelength, the method comprises steps of:

absorbing a reaction precursor onto the surface of the phosphor; and

coating the surface of the phosphor with a metal oxide by reacting said reaction precursor with a coreaction material.

23. A method for producing a phosphor for a light emitting element which absorbs a part of light emitted from the light emitting element and converts it into light with different wavelength, the method comprises steps of:

absorbing a reaction precursor onto the surface of the phosphor; and

coating the surface of the phosphor with a metal nitride by reacting said reaction precursor with a coreaction material in chemical vapor deposition.

24. The method for producing a phosphor for a light emitting element according to claim 22 or 23, wherein said reaction precursor is an organic metal.

25. The method for producing a phosphor for a light emitting element according to claim 24, wherein said organic metal contains at least one metallic element

selected from the group consisting of Al, Si, and In, Ga and the other rare earth elements.

26. The method for producing a phosphor for a light emitting element according to any of claims 22 to 25, wherein said coreaction material is any of oxygen, water vapor and ammonia.

27. The method for producing a phosphor for a light emitting element according to claim 22 to 26, wherein the method further comprises a steps of thermally treating the phosphor for a light emitting element after coating in a non-oxidation atmosphere.

28. The method for producing a phosphor for a light emitting element according to claim 27, wherein the temperature range of said thermal treatment is 150 to 1000°C, and the time is 3 to 10 hours.

29. A phosphor which converts at least a part of light with first emission spectrum into light with at least one second emission spectrum in the range different from said first emission spectrum, comprising:

a nitride group phosphor material containing N (where N is nitrogen); and

a coating material coating said nitride group phosphor material.

30. The nitride group phosphor according to claim 29, wherein said coating material is a metal nitride group material, or a metal oxynitride group material.

31. The nitride group phosphor according to claim 29, wherein said coating material forms a micro capsule.

32. The nitride group phosphor according to claim 29 to 31, wherein said coating material has a multi-layer structure formed of a plurality of different materials.

33. The nitride group phosphor according to claim 32, wherein said coating material of the multi-layer structure has a high refractive index on said phosphor

side, and a low refractive index on the surface side.

34. The nitride group phosphor according to claim 29 to 33, wherein said phosphor is a nitride group phosphor represented by L-M-N:R or L-M-O-N:R (where L contains at least one element selected from the group consisting of Be, Mg, Ca, Sr, Ba, and Zn, M contains at least one element selected from the group consisting of C, Si, Ge, Sn, Ti, Zr, and Hf, N is nitrogen, O is oxygen, and R is a rare earth element).

35. The nitride group phosphor according to claim 29 to 34, wherein said phosphor is represented by $L_xM_yN_{\{(2/3)x+(4/3)y\}}$:R, or $L_xM_yO_zN_{\{(2/3)x+(4/3)y-(2/3)z\}}$:R (where L contains at least one element selected from the group consisting of Be, Mg, Ca, Sr, Ba, and Zn, M contains at least one element selected from the group consisting of C, Si, Ge, Sn, Ti, Zr, and Hf, N is nitrogen, O is oxygen, and R is a rare earth element), and has a crystal structure.

36. The nitride group phosphor according to claim 29 to 35, wherein said phosphor is represented by $L_xM_yN_{\{(2/3)x+(4/3)y\}}$:R, or $L_xM_yO_zN_{\{(2/3)x+(4/3)y-(2/3)z\}}$:R (where $0.5 = x = 3$, $1.5 = y = 8$, $0 = z = 3$; L contains at least one element selected from the group consisting of Be, Mg, Ca, Sr, Ba, and Zn, M contains at least one element selected from the group consisting of C, Si, Ge, Sn, Ti, Zr, and Hf, N is nitrogen, O is oxygen, and R is a rare earth element), and has a crystal structure.

37. The nitride group phosphor according to claim 29 to 36, wherein said phosphor is represented by $L_xM_yN_{\{(2/3)x+(4/3)y\}}$:R, or $L_xM_yO_zN_{\{(2/3)x+(4/3)y-(2/3)z\}}$:R (where $x = 2$, $4.5 = y = 6.0$, $0.01 < z < 1.5$; $x = 1$, $6.5 = y = 7.5$, $0.01 < z < 1.5$; or $x = 1$, $1.5 = y = 2.5$, $1.5 = z = 2.5$; L contains at least one element selected from the group consisting of Be, Mg, Ca, Sr, Ba, and Zn, M contains at least one element selected from the group consisting of C, Si, Ge, Sn, Ti, Zr, and Hf, N is nitrogen, O is oxygen, and R is a rare earth element), and has a crystal structure.

38. The nitride group phosphor according to claim 29 to 37, wherein said phosphor is represented by $Ca_2Si_5O_{0.1}N_{7.9}$:Eu, $Sr_2Si_5O_{0.1}N_{7.9}$:Eu,

$(Sr_{0.5}Ca_{0.5})_2Sr_5O_{0.1}N_{7.9}$:Eu, $SrSi_2O_2N_2$:Eu, or $CaSi_2O_2N_2$:Eu, and has a crystal structure.

39. The nitride group phosphor according to claim 35 to 38, wherein the crystal structure of said phosphor is a monoclinic system or orthorhombic system.

40. The nitride group phosphor according to claim 29 to 39, wherein said phosphor contains a B element.

41. A light emitting apparatus comprising a phosphor member composed of a transparent material containing a nitride group phosphor according to claim 29 to 40, and a light emitting element, wherein said phosphor member absorbs a part of light emitted from said light emitting element and emits light with different wavelength.